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CONCEPT ATTAINMENT AS A FUNCTION OF STRESS, PERSONALITY AND SEX

by

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ABSTRACT

The purpose of this study was to examine by means of a higher order factorial design the main and the interaction effects of imposed stress, neuroticism, extraversion and sex on Brunerian-type concept attainment tasks. Sixty-four subjects were selected on the basis of extreme and combined scores on the Maudsley Personality Inventory. After classifying the subjects on the basis of extraversion-introversion combined with neuroticism or non-neuroticism into groups containing eight males and eight females, half of each group was randomly assigned to either a stress or a non-stress treatment condition. After receiving the same instructions in concept attainment, the non-stress subjects were told that the study was to gather group information concerning concept attainment strategies while the stress subjects were told that they themselves were the object of the study. All subjects completed 12 tasks.

A four-way analysis of variance indicated that groups differed significantly in concept attainment efficiency in terms of the triple interactions of environment, extraversion and sex, of neuroticism, extraversion and sex, and of environment, neuroticism and sex; in terms of the double interaction of environment and neuroticism; and in terms of the main effect of extraversion. All other effects were found to be non-significant.

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While clear-cut factorial trends were hard to find, the findings do suggest that sex differences are important sources of variation in the interaction of any two of the factors of environment, neuroticism and extraversion. Under most variables, females performed more efficiently than males. While the differences are slight in terms of non-stress, non-neuroticism, and extraversion, females seem to be very superior concept attainers in terms of stress, neuroticism and introversion.

The findings supported the hypothesis that groups differentiated on the basis of neuroticism, extraversion and sex would differ in their concept attainment efficiency, and the hypothesis that such groups would differ in the extent to which their concept attainment is affected by a stress situation.

While reinforcing the importance of considering individual differences in learning and performance, the findings also suggest a need for further study of the motivating conditions used in the classroom. It would appear that forms of verbal arousal which are generally considered helpful may in fact impair the classroom behavior of certain individuals.

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CHAPTER I

INTRODUCTION

It is a matter of common experience in the classroom that the speed and efficiency with which concepts are attained are not merely a function of the competence of the teacher and the intelligence and past achievement of the learner, but also of the personality of the learner and the motivating conditions under which learning occurs. The task of the educational psychologist in this respect, is to test the validity of this experience and, assuming that it is valid, to raise it from the status of a casual observation to that of a scientific statement. To achieve this objective he must face two major problems: first, the construction of an environment that will constitute a fair simulation of the actual conditions of classroom learning *without* "losing" the variables that form the subjects of his investigation; and second, the development of tasks that will call for the same kinds of cognitive operations that are found in concept attainment in educational subject matter.

At the outset it is admitted that what is to follow could not aspire to a solution to any of these problems, but is at best a contribution to their clarification. This contribution rests on three major advances in contemporary

psychology: (1) the work of Bruner, Goodnow and Austin on concept attainment and the cognitive processes underlying it; (2) the theoretical and research contributions made to our knowledge of personality by Eysenck, and (3) the work of Mandler, the Sarasons, Taylor, Spence and others in the area of stress as a situational variable in learning. To permit a comprehensible statement of the major hypotheses that form the subject of this investigation it will be necessary to review the background provided by the work of these psychologists.

CHAPTER II

A REVIEW OF SOME RELATED RESEARCH

(1) CONCEPT ATTAINMENT

In their A Study of Thinking, Bruner, Goodnow and Austin describe concept attainment as "the process of learning what features of the environment are relevant for grouping events into externally defined classes. (1956, p. 23) The defined classes are called concepts and the features are called attributes. They define an attribute as "any discriminable feature of an event that it susceptible of some discriminable variation from event to event". (*Ibid*., p. 26) Any attribute represents a dimension along which one may specify values. A concept, therefore, may be made up of one or more attributes each of which may vary according to one or more values.

The attainment of concepts, as analysed by Bruner *et al*, was found to develop according to procedures, plans, or regulations in decision-making strategies. Among the objectives of these patterns of decision are the following:-

a) to ensure that the concept will be attained after a minimum number of encounters with relevant instances;
b) to ensure that a concept will be attained with certainty, regardless of the number of instances one must test *enroute* to attainment;
c) to minimize the amount of strain on inference and

> memory capacity while at the same time insuring that a concept will be attained;
> d) to minimize the number of wrong categorizations prior to attaining a concept. (Ibid., p. 56)

These strategies need not reflect a conscious plan. Their existence is inferred from externally produced decisions that coincide with, or depart from, so-called ideal strategies arrived at by logical learning to meet certain demands or objectives with "maximum rationality".

Strategies are not fixed but may vary according to the nature of the concept being sought, with the kinds of premise that exist in a situation, or with the consequences of behavior. Strategies may be bifurcated according to the nature of encounter with instances. Selection strategies are employed when the learner is free to choose an instance, as in the hypothetical cases of school enterprise activities, or laboratory experimentation. When, however, the learner has no control over instances - as is usually the case in school learning - reception strategies are used. The latter type is employed in this study.

Reception strategies are primarily governed by two contingencies: (1) freedom to formulate any hypothesis desired and to reformulate this on each encounter with an instance; and (2) no control over instances encountered or in the order of their presentation. Within the limits imposed by these contingencies, Bruner et al have formalised and observed two ideal strategies named according to the

number of variables held in the initial hypothesis. If an instance of a concept is presented and if this instance contains a number (X) of variables, a distinction is made between two types of initial hypotheses possible. The first type of hypothesis contains the whole array of X variables and as such, constitutes a wholist strategy. The second type of hypothesis contains less than the whole array and leads to what is called the partist strategy. For example, if an initial instance contained one red circle in a blue wavy border, the wholist strategy demands that the instance be described completely, whereas the partist strategy permits a choice among the array of variables such as "red circle". According to Bruner _et al_, the choice of the initial hypothesis governs, in the ideal sense, the subsequent rules of decision making.

A word should be said about positive and negative, and confirming and infirming instances. An instance may be positive or negative according to whether or not it includes the concept. Thus, if an instance contains the concept, it is a positive instance. If it does not, it is negative. Whether an instance is positive or negative is announced in concept attainment tasks for each instance presented.

Since the learner, after the first card, formulates an hypothesis, each subsequent instance, whether positive or negative, may be confirming or infirming. Let us assume,

for example, that on the basis of the information presented on the first card (which, according to the usual procedure, is always a positive instance), the subject advances an hypothesis concerning the nature of the concept. The knowledge that the following card is a positive or negative instance of the true concept will permit him to maintain or reject his hypothesis. If the hypothesis corresponds exactly with the true concept, the effect of a positive instance would be one of confirmation. If, on the other hand, the hypothesis is wrong, the presentation of a positive instance will infirm the hypothesis. Negative instances will have similar effects. However, whether or not the subject actually maintains his hypothesis depends on both logical and psychological considerations.

This approach to concept attainment, chosen as being a useful base for an experimental thesis, is not without support, particularly from the U.S.S.R. The books edited by Bauer (1962), O'Connor (1961) and Simon (1957) contain numerous examples of research employing theories essentially similar to that of Bruner. Noteworthy in this respect is the work of Galparin (1957, 1961), Leontev (1961), Luria (1959), and Smirnov (1957, a and b), in all of which we find a concern with the need for, and results of, giving conceptual structure to learning activities.

The importance of Bruner for this study however lies not merely in the consideration of his theoretical

formulations but also in his approach to the measures and techniques that can be employed in concept attainment experiments. Some of these are borrowed directly and serve as the basis of variation due to the other controlled factors of personality, stress, and sex.

(2) PERSONALITY DIMENSIONS

Since the late 1940's, Eysenck has been working on the refinement of a theory of personality which assumes that (1) personality is accurately quantifiable; (2) that such quantification leads primarily to two almost completely unrelated, continuous dimensions of personality, labelled extraversion-introversion, and neuroticism; and (3) that people with personalities at or near the various extremes of the two dimensions will act differently in a predictable manner.

Eysenck's dimensions are largely due to a synthesis of a small part of Jung's theory of personality and of Pavlov's parameters of higher nervous activity. Briefly, Jung distinguished people as being primarily either extraverted or introverted. He arrived at this typology largely through clinical observation. Pavlov (1927), working along physiological lines, came to the conclusion during the course of a wide variety of experiments on learning that organisms differ physiologically on the basis of the nervous system's strength, mobility, and the balance between excitation and inhibition. While Jung's typology seems

to have been over-popular for a time (Carrigan, 1960), Pavlov's theory was largely ignored until fairly recently (Simon, 1957). While experimental work is now being done in the U.S.S.R. to quantify, elaborate and delimit Pavlov's theory (Teplov, 1961), Eysenck seems to have accepted the theory in its original form as adequate for his purposes.

The two dimensions isolated by Eysenck through factor-analysis of a wide variety of tests are extraversion-introversion and neuroticism. While the existence of these as clear-cut, unidimensional, and uncorrelated factors has not been unequivocally demonstrated (Carrigan, 1960), there would seem to be sufficient evidence for their existence to warrant their use in the present experimental study.

In factor analysis, there are four types of factors. These are error factors, which are present only on one occasion, but not on others; specific factors, which are peculiar to a single test or trait whenever it occurs; group or primary factors, common to certain of the tests or traits, but absent in others; and general or second-order factors, common to all the tests or traits used in an investigation. Eysenck's second-order factors are extraversion-introversion, and neuroticism.

Table I, taken in modified form from Eysenck (1957), shows some of the traits experimentally found to exist with

TABLE I

A LIST OF TRAITS AND THE STYLE OF THEIR OCCURRENCE IN EXTRAVERTS AND INTROVERTS

Trait	Introvert	Extravert
Intellectual function	Low I.Q./Vocab. ratio	High I.Q./Vocab. ratio
Perceptual rigidity	High	Low
Persistence	High	Low
Speed	Low	High
Speed/accuracy ratio	Low	High
Level of aspiration	High	Low
Intra-personal variability	Low	High
Sociability	Low	High
Repression	Weak	Strong
Social Attitudes	Tender-minded	Tough-minded
T.A.T.	Low Productivity	High Productivity
Conditioning	Quick	Slow
Stress reaction	Over-active	Inept

each of the dimensions of extraversion and introversion.

Eysenck has also extended his theory of personality to embrace learning theory. In line with his general theory, he has formulated two postulates in terms of which he hopes to integrate important areas of personality and learning theory. The first of these, called the Postulate of Individual Differences, runs as follows:

> Human beings differ with respect to the speed with which excitation and inhibition are produced, the strenght of the excitation and inhibition produced, and the speed with which inhibition is dissipated. These differences are properties of the physical structures involved in making stimulus-response connections. (Eysenck, 1957, p. 114)

To complete his theory, Eysenck adds a second postulate, called the Typological Postulate, which states that:

> Individuals in whom excitatory potential is generated slowly and in whom excitatory potentials so generated are relatively weak, are thereby predisposed to develop extraverted patterns of behavior...; individuals in whom excitatory potential is generated quickly and in whom excitatory potentials so generated are strong, are thereby predisposed to develop introverted patterns of behavior...; Similarly, individuals in whom reactive inhibition is developed quickly, in whom strong reactive inhibitions are generated, and in whom reactive inhibition is dissipated slowly, are thereby predisposed to develop extraverted patterns of behavior...; conversely, individuals in whom reactive inhibition is developed slowly, in whom weak reactive inhibitions are generated, and in whom reactive inhibition is dissipated quickly, are thereby predisposed to develop intraverted patterns of behavior... (*Ibid*. p. 114)

From the data in Table I, and also from the two postulates, a number of predictions have been made and tested with varying results. For the most part, Eysenck is well supported by English research (Lynn, 1963, Lynn and

Gordon, 1961, Broadbent, 1958, Lynn, 1959, Savage, 1962, Franks, 1956), but not so well by American research (Rechtschaffen, 1958, Gelfind and Winder, 1961, Becker and Matterson, 1961, Edwards, 1953, Edwards and Walker, 1962, Taylor, 1961). However, Eysenck does find strong support in North America from Bendig (1958, 1958-60, 1960, Bendig and Eigenbrode, 1961) as well as tentative support from Anderson (1962), Cattell (1959), Cattell and Scheier (1961), and Couch and Keniston (1960). Carrigan (1960) in a detailed and comprehensive review of the literature concludes that the unidimensionality of extraversion-introversion has not been unequivocally demonstrated, and that a clear-cut answer to the question of whether extraversion-introversion is independent of adjustment is not yet possible.

Despite the inconclusiveness of the research based on his theory, Eysenck seems to have sufficient empirical support to justify the use of his theory as the basis for predicting that subjects possessed of different personality dimensions will differ in concept attainment efficiency according to the presence and absence of motivating instructions.

(3) PERSONALITY AND ENVIRONMENT

Presumably, people who have higher scores on adjustment scales of whatever name - e.g. anxiety, emotionality,

or neuroticism - ought to perform differently on various tasks (e.g. Taylor and Spence, 1952). According to the Yerkes-Dodson law, anxiety should facilitate performance with simple tasks but interfere with performance with difficult tasks.

In studies designed to test these ideas of the relationship of measured anxiety to performance, the results have not always been unequivocal (Mandler and Sarason, 1952, Sarason, 1956, 1957 a and b., 1960, Sarason and Mandler, 1952 a and b, versus Spence, 1958, and Taylor, 1956 and 1961). However, investigations have shown that latent anxiety is not identical with manifest anxiety (e.g. Taylor, 1956). The standard approach to study of this problem involves the establishment of groups equated on some anxiety measure, and further subdividing them according to anxiety level. The control groups are usually placed in a neutral environment - i.e. one in which there is no reason for them to feel personally threatened. The experimental groups are placed in a stress or threat environment created, for example, by suggesting that their tasks constitute a measure of intelligence (Sarason, 1957 a). In such studies, the results are all similar. The subjects equated on anxiety perform according to expectations only in the stress situations. High anxious subjects perform more poorly under stress. Non-anxious subjects perform equally well under both stress

and non-stress situations.

While the results in such experiments are similar, the explanations offered are not. The Spence-Taylor position is that anxiety is a generalised drive of the kind postulated by Hull, and as such, strengthens already existing response tendencies, some of which may be incorrect. Mandler and the Sarasons on the other hand, argue that anxiety produces interfering responses which cause a decrement in learning or performance (cf. Nicholson, 1958).

From Eysenck's work, as well as that of the Sarasons and Mandler, it would seem that persons possessing very different degrees of neuroticism or general anxiety would react in dissimilar ways to the same task. Thus, for example, it could be postulated that the anxious subject would do his best, if for no other reason, then simply because he had to. However, the Sarasons and Mandler have shown that when these anxious subjects are given a reason for doing their best which involves them personally, either actually or apparently, these neurotic subjects perform more poorly. Conversely, the non-neurotic subject may be content to coast in his efforts until he is given personally involving reasons to extend himself. When these are given, mild stress leads to improved performance.

However, if Eysenckian theory is sound, it should be observed that extraverts and introverts would also react differently to mild stress and non-stress (cf. Table I and

postulates, pp. 9-10). This theory would suggest that extraverts would perform more poorly than introverts in a non-stress situation but that, under the influence of mild stress, the extravert would perform as well as, or better than, the introverts. One reason for this, according to Eysenck, is that the extravert is directed more by his external world than the introvert who is directed more by inner convictions. Thus, under a non-stress environment, the introvert would be reacting to normal motivation and the extravert to little or no motivation. However, under mild stress, the introvert should find the extra motivation a little more than enough for peak performance, while the extravert now finds a reason for doing well.

Given the above, the question raised is how subjects falling into any of the combinations of high and low neuroticism, extraversion and introversion will react to mild stress. The literature upon which this thesis is primarily based would suggest that under non-stress conditions, the neurotic introverts should perform at a higher level than the non-neurotic extraverts. Under mild stress, however, the non-neurotic extraverts should perform at a higher level than the neurotic introverts.

(4) SEX

The need to study the influence of sex has been raised in connection with extraversion-introversion by

Carrigan (1960), and with anxiety by Sarason (1960).

Specifically, a question to be investigated is whether males and females equated on extraversion, introversion and emotionality react similarly under similar environments of stress and non-stress.

CHAPTER III

THE PROBLEM

This study is primarily concerned with the effect which certain definable and observable factors have on concept attainment. The factors chosen for study were sex, environment, extraversion-introversion, and neuroticism.

(1) OPERATIONAL DEFINITIONS

1. Mild Stress Environment

This is assumed to be a situation in which the subject is, or ought to be, personally involved. The type of stress in question should be invoked by the following sorts of statements:- "This is important for you". "Do your best." "This could make you or break you." "People will be observing you." "This will indicate how intelligent you are."

2. Non-stress Environment

This is assumed to be a situation in which the subject's attention is directed away from himself. To do this, statements such as the following might be used:- "We are only concerned with the usefulness of tasks like this for a group such as yours." "The only results of any importance are group results." "The only person who can fail in this project is the examiner."

3. Extraversion

This is represented by a score of 31 or more - to a maximum of 50 - on the E scale of the M. P. I. (Maudsley Personality Inventory).

4. Introversion

This is represented by a score of 18 or less - to a minimum of 0 - on the E scale of the M. P. I.

5. Neuroticism

This is represented by a score of 26 or more - to a maximum of 50 - on the N scale of the M. P. I.

6. Non-neurotic

This is a person with a score of 14 or less on the N scale of the M. P. I.

7. Non-neurotic Extravert

This is a person with an N-score of 14 or less and an E-score of 35 or more.

8. Neurotic Extravert

This is a person with an N-score of 26 or more and an E-score of 31 or more.

9. Non-neurotic Introvert

This is a person with an N-score of 14 or less and an E-score of 18 or less.

10. Neurotic Introvert

This is a person with an N-score of 26 or more and an E-score of 16 or less.

11. Concept Attainment

This is regarded as problem-solving involving convergent thinking, the utilization of presented cues, and the memorization of presented information.

(2) ASSUMPTIONS

1. That the Maudsley Personality Inventory is a reliable and valid measure of neuroticism and extraversion.
2. That mild stress was in fact evoked by the instructions used in the experiment.
3. That little or no stress was evoked in the non-stress groups during the course of the experiment.
4. That, although no measure of intelligence was taken, since the subjects were a random sample from a fourth year university course and thereby, presumably, all of above average intelligence, and further, since group rather than individual scores were to be used in the analysis of results, then variation due to intelligence was not a major factor to be controlled.

(3) GENERAL DISCUSSION OF THE PROBLEM

It was partly to determine whether individual differences manifested themselves in concept attainment that personality dimensions were employed in this study. According to the work of Eysenck and his associates, different results should be achieved by subjects possessing

different basic personality patterns. However, their work has not yet involved concept attainment.

Also involved under the heading of individual differences is the question of the sex of the subject. Different rates of maturation, learning to read, and ability to spell have previously been found. This study will now attempt to discover sex differences in concept attainment.

Finally, the study will attempt to shed light on variations in concept attainment due not only to individual differences but also to phenomonological environments. More specifically, an attempt will be made to determine what interactions occur when subjects of various personality dimensions and of different sex attain concepts under conditions of mild stress and non-stress.

(4) FORMAL HYPOTHESES

1. Groups differentiated on the basis of neuroticism, extraversion-introversion, and sex will differ in their concept attainment efficiency.

2. Such groups will differ in the extent to which their concept attainment performance is affected by a stress situation.

CHAPTER IV

EXPERIMENTAL DESIGN

(1) THE SAMPLE

The Maudsley Personality Inventory was administered to the 280 students taking Ed. Psych. 476 during the 1963 Summer Session. From this population, those 80 who scored at the extremes of the combined N and E scales were invited to participate in an experiment on concept attainment. Of these, 72 reported as expected. The criteria used for deciding the cut-off scores was that each section of the distribution selected had to be at two extremes of the scales and contain at least 4 males and 4 females. Figure 1 illustrates the selection procedure followed. Table II contains the population data on the M. P. I. Table III contains the M. P. I. group data for the experimental groups.

As Table III indicates, the smallest gap in score between a subject classed as an introvert and one classed as an extrovert is 15 points on the E scale, while the smallest such gap in group means is 20 points. Similarly, the smallest gap in individual scores between subjects classed as neurotics as opposed to non-neurotics is 12 points while the smallest such gap in group means is

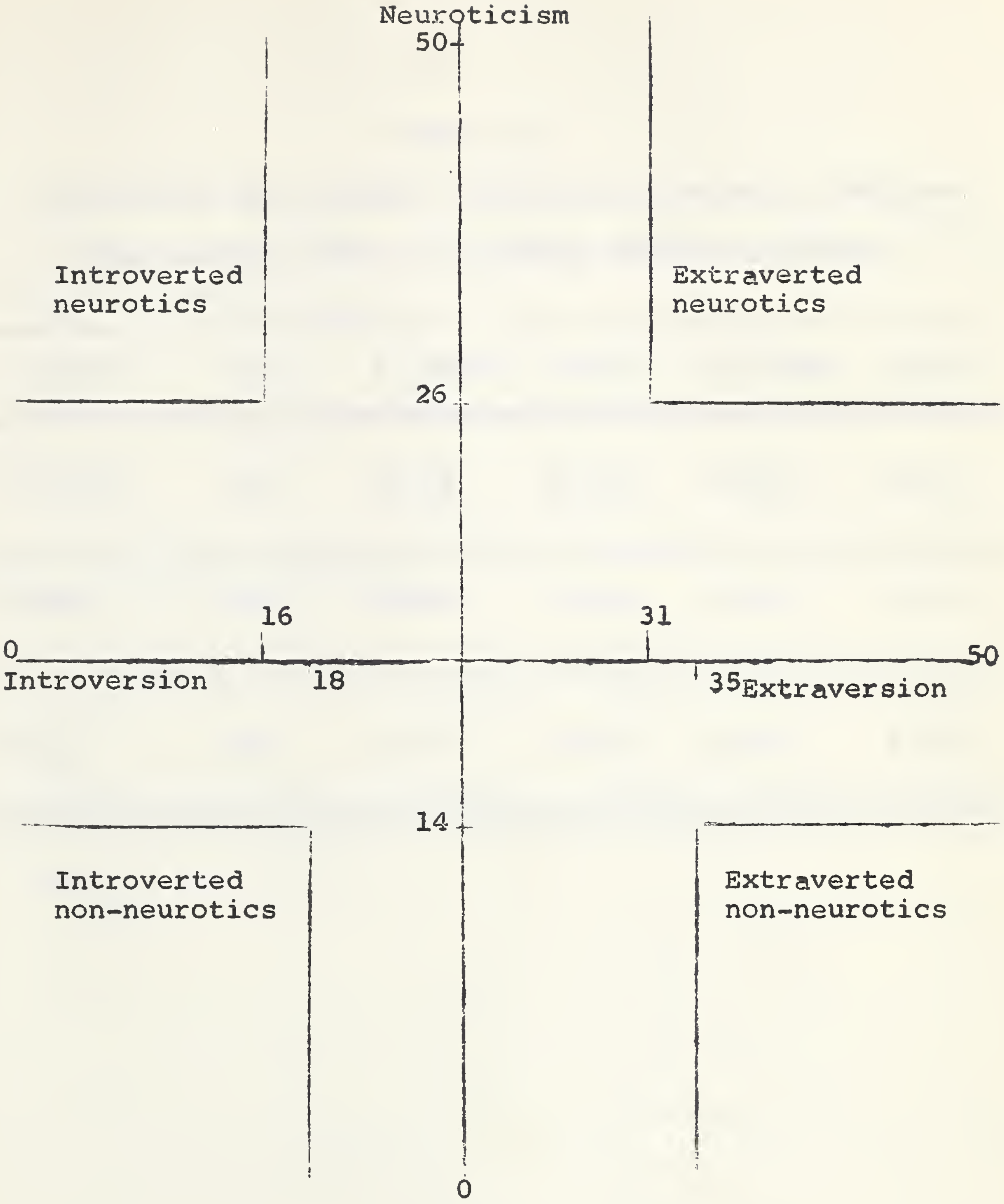

Figure I

Areas of the distribution of the population scores on the M.P.I. included in the experimental sample.

TABLE II

RESULTS OF THE MAUDSLEY PERSONALITY INVENTORY OBTAINED FROM 280 ED. PSYCH. 476 SUMMER SESSION STUDENTS.

Group	No.	N. mean	N.S.D.	E. mean	E.S.D.
females	145	19.69	10.28	25.83	9.40
males	135	19.44	9.20	25.36	9.70
Total	280	19.57	9.78	25.60	9.56

TABLE III

FEMALE, MALE AND TOTAL GROUP MEAN SCORES AND RANGES ATTAINED ON THE NEUROTICISM AND EXTRAVERSION SCALES OF THE M.P.I. BY SUBJECTS USED IN THE EXPERIMENT.

Group	Number	N Mean	N Range	E Mean	E Range
Extraverted neurotics					
Females	8	36.88	28-45	37.00	31-41
Males	8	33.88	26-46	34.63	31-48
Total	16	35.38	26-46	35.81	31-48
Extraverted Non-neurotics					
Females	8	7.13	1-14	38.63	35-43
Males	8	6.75	0-14	37.63	31-39
Total	16	6.94	0-14	38.13	31-43
Introverted Neurotics					
Females	8	33.88	26-42	9.25	0-16
Males	8	30.00	26-48	9.38	8-16
Total	16	31.94	26-48	9.31	0-16
Introverted Non-neurotics					
Females	8	8.75	8-14	13.63	4-18
Males	8	6.75	0-14	14.63	6-18
Total	16	7.75	0-14	14.12	4-18

21.25 points. While it was recognized as desirable to maximize the gap in scores between subjects in each group beyond 12 and 15 points, it was arbitrarily decided to make do with subjects scoring as they did from the initial sample. It seemed reasonable to expect group mean differences of over two standard deviations to minimize sufficiently the possibility of contaminated results due to the overlap in individual true scores.

(2) TESTS USED

The only formal test used was the Maudsley Personality Inventory. This is a 48 item paper and pencil test which purports to give a "rough-and-ready measure of two important personality dimensions: Neuroticism, or emotionality, and Extraversion." (Eysenck, 1959) Each is measured by 24 items. Reliability coefficients have been found to range between .83 and .90 on the Neuroticism scale, and between .75 and .85 on the Extraversion scale.

According to Eysenck (1959), N correlates with the Heron (.64) and Cattell (.34) neuroticism scales, the Guilford C scale (.92), and the Taylor scale (.77). E correlates with the Heron (.80) and Cattell (.53) extraversion scales, the Guilford R scale (.79), the Minnesota sociability scale (.81), and negatively with the Taylor scale (.35). Bendig (1960) has also found that Taylor's M.A.S. and Eysenck's M.P.I. appeared to be the best "markers" for

the "emotionality" factor which is measured by inventories of anxiety or neuroticism, and that the M.P.I. was the most useful of the inventories studied for defining extraversion-introversion.

A concept attainment test was also used based on Bruner *et al* (1956, pp. 134-152). Instances presented were cards containing various numbers, colors and kinds of borders, and various numbers, colors and shapes of figures. The six attributes, each having three values, were:

Number of figures	1, 2 or 3
Color of figures	blue, green or red
Shape of figures	circle, cross or square
Number of borders	1, 2 or 3
Color of borders	blue, green or red
Kind of borders	dotted, solid or wavy.

There were thus 3x3x3x3x3x3, or 729, possible instances of which 72 were actually used with the stipulations that none would be used more than once, and that the first one for each task would be chosen at random.

To equate task difficulty exactly over groups, the same twelve tasks were used throughout the experiment. A full description of each task can be found in Appendix A. The first task and every second one thereafter consisted of 5 instances, while the second task and every second one thereafter consisted of 7 instances. After the instances for each task had been selected, the order of presentation

was determined randomly with the restriction that the first and last instance presented would be an example of the concept being sought. In order to reduce the strain on memory, the number of relevant attributes for each task was systematically varied from three to six. The number of attributes in each concept was varied from one to three.

Table IV contains a summary of the number of concept and relevant attributes used in each of the twelve tasks. Table V contains a summary of the frequency of appearance of number of concept and relevant attributes in both the five and the seven instance tasks.

Brunerian-type concept attainment tasks were chosen for use in the experiment because of their face validity in the study of concept attainment, their previous use in group administration, and because they meet the criteria outlined by Garner (1962) for experiments on concept formation. Garner suggests (pp. 310-312) that the two basic characteristics to be observed in the procedure of concept formation experiments are first, that the same response must be used for more than one stimulus before the subject can be considered to be using a concept, and second, that the stimuli must be multivariate in nature. The tasks used meet both criteria.

(3) THE EXPERIMENTAL DESIGN

In order to study more completely some of the factors affecting concept attainment, it was decided to use

TABLE IV

SUMMARY OF INSTANCES PRESENTED, NUMBER OF ATTRIBUTES IN THE CONCEPT AND RELEVANT ATTRIBUTES IN THE TASK FOR EACH TASK IN THE EXPERIMENT.

Problem No.	Instances Presented	Relevant Attributes	Attributes in Concept
1	5	3	1
2	7	4	1
3	5	5	2
4	7	6	2
5	5	4	1
6	7	5	2
7	5	6	2
8	7	3	1
9	5	5	3
10	7	6	3
11	5	3	2
12	7	4	2

TABLE V

SUMMARY OF THE FREQUENCY OF APPEARANCE OF NUMBER OF CONCEPTS AND NUMBER OF RELEVANT ATTRIBUTES IN TASKS OF FIVE AND SEVEN INSTANCES.

Number of Instances	Number of Relevant Attributes				Number of Concept Attributes		
	3	4	5	6	1	2	3
5	2	1	2	1	2	3	1
7	1	2	1	2	2	3	1

a higher-order factorial design. The main advantages of a factorial design according to Winer (1962) include first, evaluating the combined effect of two or more experimental variables when used simultaneously (i.e. interaction effects); second, increasing the predictability of the results to a more inclusive population; and third, effectively accounting for a broader range of relevant variables.

Four factors having two levels each were included for study. The factors, their levels and their notation were:

Factor A:- Environment	a-1 non-stress
	a-2 stress
Factor B:- Neuroticism	b-1 neurotic
	b-2 non-neurotic
Factor C:- Extraversion	c-1 extravert
	c-2 introvert
Factor D:- Sex	d-1 male
	d-2 female

The experimental scheme is represented in Table VI which shows that there were 4 subjects per cell. It also shows that each of the four factors is represented by 32 subjects, that each level of each factor is represented by 32 subjects, that any combination of any two levels is represented by 16 subjects, and that any combination of any three levels is represented by 8 subjects. It is only when four levels are considered together that the number of

TABLE VI

SCHEMATIC PRESENTATION OF EXPERIMENTAL DESIGN, INCLUDING CELL FREQUENCIES AND DIMENSIONAL SUB-TOTALS.

	Male		Female		
	Stress	Non-Stress	Stress	Non-Stress	Totals
Extraverted neurotics	4	4	4	4	16
Extraverted non-neurotics	4	4	4	4	16
Introverted neurotics	4	4	4	4	16
Introverted non-neurotics	4	4	4	4	16
Totals	16	16	16	16	64

subjects involved is as small as 4.

After selecting the sample, subjects fitting the B C D factorial criteria were randomly assigned to either the stress or non-stress treatment. Since 80 subjects were invited to participate and 72 actually did, some cells had more than 4 subjects in them. At the conclusion of the experiment, those cells with more than 4 subjects were reduced to 4 by assigning numbers to each subject and randomly selecting a number to be eliminated. In no case was it necessary to eliminate more than one per cell.

Each of the four factors is assumed to be fixed. For example, for classification purposes in this experiment, an extravert either is or is not neurotic. Conversely, a neurotic either is extraverted or introverted.

The analysis of variance which results from a 2^4 factorial experiment may include information on the main effects due to 4 single factors, and on the variation due to 6 two-factor interactions, 4 three-factor interactions, and 1 four-factor interaction.

Statistical assumptions demanded by the present design include: 1) a random sample of subjects for each level of each factor; 2) that the average of the interaction effects over both levels of any factor is independent of the main effects of any other factor; 3) that the sampling of the levels of one factor are independent of the sampling of the levels of the other factors; 4) that

the experimental error is independent of all main effects and all interaction, and also, that within each cell, the experimental error is assumed to be normally distributed, with mean equal to zero and variance equal to σ_ε^2 for all cells in the population; and 5) that the "n" observations within each cell of the experiment constitute an independent random sample of "npg" independent elements drawn from the basic population "N". (cf. Winer, 1962, p. 155-6).

Assumptions 1), 3) and 5) have been met. Since this is so, the violation of the assumption of homogeneity of variance in 4) will not seriously bias the final F tests (cf. Ibid. p. 123, and p. 219. Also Scheffé, 1959, pp. 331-364.) The second assumption made, implying the effects of covariance, is more difficult to cope with since the effects of one factor on the interaction of, for example, two others is unknown. Scheffé, commenting on the difficulty of meeting this assumption, recommends equal cell numbers as the simplest safeguard. (Ibid., p. 364) This precaution has been taken.

The criterion measure used to measure the effect and interaction of the four factors were the concept attainment tasks. Each subject could attain a score from 0 to 12 inclusive. The measure of his success depended on the number of concepts attained. No marks were given for part concepts attained.

Scheffé suggests that in an analysis of variance,

the F-test may frequently be regarded as a preliminary statistical technique to find if any differences significant from zero exist in the observed data. A significant F-test indicates the existence of such real differences between cell totals (where n's are equal) or between cell means (*Ibid*., p. 71).

To test for these significant differences, Scheffé has developed the S-method of judging all contrasts. In the case of a fixed-effects model, a critical value for all interaction contrasts is calculated by multiplying the denominator of the F-ratio by a constant, $S=(q\ F_{\alpha};\ q,\ n-r)^{\frac{1}{2}}$ where the $M.S._{error}$ is multiplied by S and $q=(I-1)(J-1)(K-1)$, and $n-r=$d.f. of the $M.S._{error}$ term. (*Ibid*., pp. 66-72, and p. 109-110).

The critical value derived is considered to be a guaranteed (1-*alpha*) confidence coefficient. (*Ibid*., p.71) It is considered the most conservative of the multiple comparison methods by Winer (1962) who agrees with Scheffé that the type1 error on all tests of differences between pairs has a level of significance which is at most equal to *alpha*. A further advantage of the S-method over other multiple comparison techniques is that it is known to be insensitive to violations of the assumptions of normality and of equality of variance (Scheffé,1959, p. 77).

(4) EXPERIMENTAL PROCEDURE

It was originally intended to have 4 groups of 20 subjects attend each session. The first two groups were to be tested under non-stress conditions and the next two under stress conditions. The four sessions were to be on successive days.

For a multitude of reasons, it was necessary to modify the original plan. On each of the first two days, 17 subjects showed up, 13 showed up on the third day and 11 on the fourth. It was then necessary to contact those portions of the samples that had missed and arrange new dates. This resulted in a fifth and non-stress session being held and attended by 3 subjects, a sixth and stress session attended by 5 subjects, and a seventh and stress session attended by 6 subjects. In tabulating the data, it was found that the basic requirement of four subjects per cell had been met and so no further sessions were held.

At each concept attainment session, the main portion of the instructions given were the same. The exact instructions given can be found in Appendix B. Basically, these included an explanation of what a concept is, what is meant by an attribute, a relevant and irrelevant attribute, and a positive and negative instance. Cards were shown containing various combinations of attributes, and instruction and practise was then given in reading these cards and finding concepts. The nature of the work to be done by

each subject was then explained. They were told how to participate in a task by looking at each card, which was verbally labelled as a positive or a negative instance, guessing at the concept and then recording their guess for each card which was presented. They were told that each instance would be shown for 10 seconds and that there would be a 4 second gap between cards. They were to record their guesses at any time after making them. It was emphasized that after making each guess, that guess and all previous ones were to be covered. Subjects were thus to rely on their memory of previous instances presented for a total period of 70 seconds for a 5 card task or 98 seconds for a 7 card task. Generally, subjects seemed to adhere to this rule although a lack of complete supervision did make it possible for subjects to look at previous guesses without being detected.

After giving all groups the same general instructions, different explanations of the purpose of the experiment were given to the stress and the non-stress groups. The non-stress groups were told that the purpose was to study, on the basis of their group data, the patterns of solution used in concept attainment. The stress groups were told that their responses should indicate their ability to do university work easily. In other words, they were told, these tasks could be regarded as an intelligence test measuring their problem-solving ability. Finally, a

few words were added to indicate that the Ed. Psych. 476 instructors were interested in possibly considering the results for evaluation purposes.

After these instructions and explanations, the tasks were presented. Because 20 subjects per group were expected, it was originally intended to flash the cards on a screen by means of an overhead projector. This was done with the first two groups. However, with the smaller groups, since the cards could be seen from any portion of the room, it was decided to show the cards from the front of the room.

At the conclusion of each session, subjects were asked to refrain from discussing the proceedings with other students to avoid the possibility of giving some other subjects an undue advantage. After the stress session, it was also explained that nobody but the experimenter would see the individual results of the experiment, and that the purpose of the experiment had been to see how the subjects reacted to a form of instruction frequently used in the classroom to motivate pupils. This added explanation was usually followed by a variety of expressions of relief by these subjects.

CHAPTER V

EXPERIMENTAL RESULTS

The effects of non-stress and stress instructions on the concept attainment efficiency of the various groups were analyzed by comparing group-total raw scores. A four way analysis of variance was used to test for significant results due to neuroticism, extraversion, sex and environment. (cf. Winer, 1962, pp. 278-281 and 286-7). Table VII contains a summary of the data obtained. An examination of Table VII shows that, although the whole group totals obtained under stress and non-stress conditions are almost identical, the row and column totals show considerable variations in most cases.

The summary of the analysis of variance is reported in Table VIII. This table shows that the triple interactions of environment, extraversion and sex, and of neuroticism, extraversion and sex were found significant at the .05 level, and that of environment, neuroticism and sex was significant at the .25 level. There was also a significant interaction between environment and neuroticism at the .10 level, and a main effect due to extraversion significant at the .25 level.

To permit a closer examination of the differences

TABLE VII

RAW SCORES OBTAINED ON CONCEPT ATTAINMENT TASKS BY GROUPS ARRANGED ACCORDING TO FOUR FACTORS: EXTRAVERSION, NEUROTICISM, SEX AND ENVIRONMENT.

	Male		Female		Totals	
	Non-Stress	Stress	Non-Stress	Stress	Non-Stress	Stress
Extraverted neurotics	17	22	33	34	50	46
Extraverted non-neurotics	24	34	21	26	45	60
Introverted neurotics	29	16	23	19	52	35
Introverted non-neurotics	23	13	19	34	42	47
Totals	93	85	96	103	189	188
Extraverts	41	56	54	50	95	106
Introverts	52	29	42	53	94	82
Neurotics	46	38	56	43	102	81
Non-neurotics	47	47	40	60	87	107

TABLE VIII

SUMMARY OF ANALYSIS OF VARIANCE FOR RAW SCORES OBTAINED ON 12 CONCEPT ATTAINMENT TASKS, BY SUBJECTS CLASSIFIED ALONG FOUR DIMENSIONS.

Source of Variation	SS	df	MS	F (1,48)	Level of Significance
A (environment)	0.02	1	.02	-	
B (neuroticism)	1.89	1	1.89	-	
C (extraversion)	9.77	1	9.77	1.40	.25
D (sex)	6.90	1	6.89	-	
AB	26.25	1	26.25	3.77	.10
AC	8.26	1	8.26	1.19	N.S.
AD	3.51	1	3.51	-	
BC	.77	1	.77	-	
BD	1.27	1	1.27	-	
CD	0.77	1	0.77	-	
ABC	0.15	1	0.15	-	
ABD	9.77	1	9.77	1.40	.25
ACD	43.89	1	43.89	6.30	.05
BCD	37.52	1	37.52	5.36	.05
ABCD	0.74	1	0.74	-	
Within cell	334.75	48	6.97		

in cell totals found in the significant triple interactions, three-way summary tables of the results and of the differences are included on the following pages. Applying the S-method formula for multiple comparisons (cf. p.34), the critical value for differences due to triple interactions in this study is $(6.98)((1x4.05)^{\frac{1}{2}})=14.051$ when *alpha* = .05. This critical value applies only to the following cell differences and not to row or column differences.

Table IX summarizes the results for the interaction of environment, extraversion and sex which was found to be significant at the .05 level. The results indicate no difference between levels of environment, a difference of 21 in favor of females over males, and a difference of 25 in favor of extraverts over introverts.

Table X summarizes the absolute differences between levels of each factor taken three at a time. Seven of these differences exceed the critical value. Of these, five involve introverted males in a stress environment who did significantly poorer than extraverted females and introverted males under non-stress conditions, and extraverted males, extraverted females, and introverted females under stress. The other significant differences involve extraverted males who did significantly better under the stress condition than either the extraverted males or the introverted females under non-stress.

The data involved in the 3-factor interaction of

TABLE IX

SUMMARY OF THE RAW SCORE RESULTS FOR THE INTERACTION OF ENVIRONMENT, EXTRAVERSION AND SEX ACCORDING TO LEVELS

	d1(male		d2(female)		
	C1 (Extravert)	C2 (Introvert)	C1	C2	Totals
a1 (non-stress)	41	52	54	42	189
a2 (stress)	56	29	50	53	188
Totals	97	81	104	95	377

TABLE X

SUMMARY OF THE DIFFERENCES BETWEEN ALL CELL TOTALS OF THE TRIPLE INTERACTION OF ENVIRONMENT, EXTRAVERSION AND SEX

	121	112	122	211	221	212	222
111	-11	-13	-1	-15*	12	-9	-12
121		-2	10	-4	23*	2	-1
112			12	-2	25*	4	1
122				-14*	13	-8	-11
211					27*	6	3
221						-21*	-24*
212							-3*

* Significant at the .05 level

Where	represents	
1..		non-stress
2..		stress
.1.		extraverts
.2.		intraverts
..1		males
..2		females

neuroticism, extraversion and sex, which is significant at the .05 level, is contained in Table XI. Examination of the table reveals a slight superiority of non-neurotics over neurotics (d=11), a greater superiority of females over males (d=21), and a slightly even greater superiority of extraverts over introverts (d=25). Within the cells, the three highest totals in descending order are those of non-neurotic, extraverted males, neurotic extraverted females, and non-neurotic introverted females. The two lowest totals in ascending order were attained by non-neurotic introverted males, and by neurotic extraverted females. With the exception of the apparent superiority of females over males, no definite trend is evident on the basis of these factors.

Table XII summarizes the absolute differences between levels of each factor taken three at a time. Although eight differences were found to be significant at the .05 level, again no trend is discernible. Three significant differences were found between the poorly performing non-neurotic introverted males and the non-neurotic extraverted males, the neurotic extraverted females, and the non-neurotic introverted females. The non-neurotic extraverted males were also found to be superior to the neurotic extraverted males and to the neurotic introverted females. The neurotic extraverted females were also superior to the neurotic extraverted males and to the neurotic intro-

TABLE XI

SUMMARY OF THE RAW SCORE RESULTS FOR THE INTERACTION OF NEUROTICISM, EXTRAVERSION AND SEX ACCORDING TO LEVELS.

	d1 (male)		d2 (female)		Totals
	c-1	c-2	c-1	c-2	
	Extravert	Introvert			
b-1 (neurotic)	39	45	57	42	183
b-2 (non-neurotic)	58	36	47	53	194
Totals	97	81	104	95	377

TABLE XII

SUMMARY OF THE DIFFERENCES BETWEEN ALL CELL TOTALS OF THE TRIPLE INTERACTION OF NEUROTICISM, EXTRAVERSION AND SEX.

	121	112	122	211	221	212	222
111	-6	-18*	-3	-19*	3	-8	-14*
121		-12	3	-13	9	-2	-8
112			15*	-1	21*	10	4
122				-16*	6	-5	-11
211					22*	11	5
221						-11	-17*
212							-6

* Significant at the .05 level

Where	1..	represents	neurotics
	2..		non-neurotics
	.1.		extraverts
	.2.		introverts
	..1		males
	..2		females

verted females. Besides being superior to the non-neurotic introverted males, the non-neurotic introverted females were also superior to the neurotic extraverted males.

Table XIII contains the summary data of the significant at the .25 level interaction of environment, neuroticism and sex. This data indicates that, taken as a whole, there is little fluctuation between levels of environment (d=1), that non-neurotics tend to do better than neurotics d=11), and that females do much better than males (d=21). The within cell totals are highest for female non-neurotics under stress and for female neurotics under non-stress. The lowest cell totals are for male neurotics under stress and for female non-neurotics not under stress. Table XIII again reveals, as did Table IX, marked fluctuations within the sex factor of the interaction of environment and neuroticism. Thus, while under non-stress conditions there is virtually no difference between male neurotics and non-neurotics, the female neurotics performed much more efficiently than the female non-neurotics. However, under stress, the male non-neurotics tended to do better than the male neurotics. The same phenomena was exhibited by the females. In other words, the present findings suggest that whereas neurotics are generally hampered in concept attainment by stress conditions, male non-neurotics seem unaffected and female non-neurotics seem successfully motivated by the same conditions.

TABLE XIII

SUMMARY OF THE RAW SCORE RESULTS FOR THE INTERACTION OF ENVIRONMENT, NEUROTICISM AND SEX ACCORDING TO LEVELS.

	d1 (male)		d2 (female)		Totals
	c-1	c-2	c-1	c-2	
	Extravert	Introvert			
b-1 (neurotic)	39	45	57	42	183
b-2 (non-neurotic)	58	36	47	53	194
Totals	97	81	104	95	377

When sex is not a factor, the significance of the 2-factor interaction between environment and neuroticism seems accountable largely by the good neurotic against the poor non-neurotic performance under non-stress (d=15) compared to the opposite results of the poor neurotic versus the good non-neurotic performance under stress (d=26).

Table XIV summarizes the differences between the factors of environment, neuroticism and sex taken three at a time. The non-neurotic females under stress did significantly better than the neurotic male and the neurotic female under stress, and than the non-neurotic female and the neurotic male under non-stress. The neurotic female under non-stress did significantly better than the non-neurotic female under non-stress, and than the neurotic male under stress.

TABLE XIV

SUMMARY OF THE DIFFERENCES BETWEEN ALL CELL TOTALS OF THE TRIPLE INTERACTION OF ENVIRONMENT, NEUROTICISM AND SEX.

	121	112	122	211	221	212	222
111	-1	-10	6	8	-1	3	-14*
121		-9	7	9	0	4	-13
112			16*	18*	9	13	-4
122				2	-7	-3	-20*
211					-9	-5	-22*
221						4	-13
212							-17*

* Significant at the .05 level

Where	1..	represents	non-stress
	2..		stress
	.1.		neurotics
	.2.		non-neurotics
	..1		males
	..2		females

CHAPTER VI

DISCUSSION OF THE RESULTS

The hypothesis that groups differentiated on the basis of extraversion, neuroticism and sex would differ in their concept attainment efficiency received empirical support in this study. This suggests that individual differences in a study of concept attainment cannot be ignored without imposing limitations on ensuing results.

Similarly, the hypothesis that such groups would differ in their concept attainment in a stress situation also received empirical support. Since the stress environment was not unlike the motivating comments frequently used in the classroom, the findings appear to have important educational implications.

Of special interest in the analysis of the results was the finding that although subjects differentiated on the basis of neuroticism, extraversion and sex differ in their concept attainment efficiency under both non-stress and stress conditions, the only dimension, taken singly, with significant variations between means is extraversion-introversion. Otherwise, the significance of the results lies in the interaction of the factors, and especially in their triple interactions.

Carrigan (1960) and Sarason (1960) have both

emphasized the need to study the relationship between sex and personality characteristics with regard to responses to conditions of implied threat (Sarason) and to the manifestation of extraversion-introversion and emotionality (Carrigan). The findings appear to bear them out.

The interaction of environment, extraversion and sex would suggest that differences found in concept attainment can best be explained by the sex factor. On the whole, concept attainment in females cannot be differentiated on the basis of extraversion-introversion. They do about as well whether they are extraverts or introverts with a slight superiority in favor of the extraverts. However, the male introverts were definitely inferior to the male extraverts. Females as a group do better than males. Female extraverts do better than male extraverts, and female introverts do better than male introverts. Male extraverts and female introverts appear to react to ego-involving instructions with improved concept attainment, male introverts find such instructions very disruptive, and female extraverts are virtually unaffected.

Further support for the importance of sex is gained from considering the extremely non-significant interaction between environment, neuroticism and extraversion. Despite numerous findings in the literature (e.g. Sarason, 1960) concerning the decremental effect of stress inducement on neurotic or anxious subjects, this finding suggests that,

in the absence of a sex factor, this influence may have been over-emphasized.

Thus, when Bendig (1958) concludes that subjects selected for experimental studies on the basis of extreme scores on the M.P.I. scales should not differ on learning and retention measures, the question arises as to whether sex was a controlled variable in his study.

Similarly, when Eysenck, and Lynn and Gordon (1961) set out characteristics of introverts and extraverts related to educational attainment, it seems justifiable to wonder what effect controlled sex differences might have had on their findings.

The significant interaction between neuroticism, extraversion and sex lends special support to the study's first hypothesis concerning differential concept attainment efficiency. Within the three dimensions themselves, it was found that extraverts did much better than introverts, females did better than males, and non-neurotics did slightly better than did neurotics. However, consideration of the interaction results reveals the danger inherent in generalizing from simple effects.

The two most efficient groups in terms of three factors were those containing non-neurotic extraverted males, and neurotic extraverted females. The two poorest contained non-neurotic introverted males, and neurotic extraverted males. In the two best group performances,

only the dimension of extraversion appears, and only maleness appears in both of the poorest.

The third interaction with some significance involved environment, neuroticism and, for the third time, sex. This time, the findings show the females to be superior to their male counterparts in three out of four cases, with only the non-neurotic male showing a slight superiority over the non-neurotic females under non-stress conditions. Both male and female neurotic subjects were found to react adversely to stress, the male non-neurotics were unaffected by it, and the female non-neurotics attained concepts very much better.

In the two 3-factor interactions significant at the .05 level, extraversion and sex appear in each but the third factor in one is environment in the form of imposed stress or non-stress, while the third factor in the other is neuroticism. It appears that both interactions have a great deal in common since in one the third factor is induced anxiety while latent anxiety is in the other. It would appear that these interactions can be partly differentiated on the basis of the direction in which emotionality is introduced. In the one case it is imposed from without while in the other it is imposed from within.

A comparison of the data in Tables IX and XI reveals that when the only factor altered in the interaction terms is the nature of the arousal factor, the data

for the females is almost identical from one table to the other. However, the performance of the males is apparently altered by the change from inner to outer arousal. The male neurotic introverts do significantly better than the male introverts under stress, while the male non-neurotic introverts do slightly more poorly than do the male introverts under non-stress conditions. However, whereas the extraverted males do significantly better in a stress rather than in a non-stress situation, the neurotic extraverted males do significantly poorer than do the non-neurotic extraverted males.

This comparison seems to lend some support with respect to males to the idea that arousal, whether latent or induced, has an important effect on concept attainment. While this idea may partially explain the male portion of the two most significant gross findings in this study, the specific findings suggest that the direction of the effect of the two types of arousal is dependent on extraversion and introversion.

Another interpretation is available for the findings which couple neuroticism and stress. According to the Yerkes-Dodson law, the optimum drive required for efficient learning is inversely related to the complexity of the task. It could be argued that neurotics under stress conditions have a very high drive level. Similarly, it could be argued that concept attainment tasks involving three

levels of each of six variables are fairly complex. If both arguments were accepted, then it could be concluded that neurotics under stress conditions were too aroused to cope efficiently with Brunerian-type concept attainment tasks.

However, the possibility of becoming embroiled in controversy exists even here. According to Spence and Taylor, who follow Hull, efficiency is the result of a multiplicative function between drive and reaction potential. If this were so, then the neurotics, if they are equally as capable as the non-neurotics, should outperform the non-neurotics under stressful conditions. In fact, the data suggest that very much the opposite occurs. This is explained by the Sarasons and Mandler on the basis of an interfering-response theory. They argue that heightened drive due to anxiety or stress causes the individual to attend to irrelevant stimuli. As a result, they predict that ego-orienting arousal of the type used in the present study will have a detrimental effect on the performance of those subjects already prone to worry about things in general and themselves in particular. The present findings seem to lend empirical support to the interference-response theory while weakening by implication the drive incremental one of Hull et al.

Particularly striking evidence of the differential interaction of environment and neuroticism is to be found

in the present study. As a whole, neurotics were almost as superior to non-neurotics under non-stress conditions as non-neurotics were to neurotics under stress. This finding lends support to the notion that motivating unemotional subjects before a learning experience might improve their learning but the same instructions to emotional subjects might cause their performance to suffer. This appears to be so at least when sex and extraversion are disregarded.

In terms of any one of the factors but sex, the literature is replete with experimental support for each finding. Thus a study by Couch and Keniston (1960) found that yeasayers, who were termed extraversive, have a pervasive readiness to respond or yield to inner and outer forces demanding expression while naysayers, who were termed introversive, have a pervasive unwillingness to respond to impulsive or environmental factors. This might account in part for the fine performance by some of the extraverts, and the poor performance by some of the introverts. It leaves unanswered, however, the opposite results wherein extraverts did poorly and introverts did well.

Similarly, Nicholson (1958), Sarason (1960), Korchin and Levine (1957), and Lynn and Gordon (1961) offer various findings to explain why and when anxious or neurotics do better or poorer than non-neurotics. Nicholson found that anxious subjects did poorly under stress but

but otherwise did as well as non-anxious subjects. Sarason (1960) concludes the same thing in a review of the pertinent literature. Korchin and Levine (1957) stress that task difficulty will determine whether anxious subjects do well or poorly. On simple tasks they do as well as non-anxious subjects but on difficult tasks they do more poorly. Lynn and Gordon (1961) reaffirm this finding and conclude that highly anxious subjects are better on simple tasks but not on complex ones.

Trying to relate these findings to the present study, it would seem that perhaps neurotics did well because they were not under stress and the tasks were simple. However, they did poorly because they were under stress and the tasks were difficult. What seems most apparent is that previous studies account only partially for the present findings.

The difficulty throughout this discussion has been to try to generalize the findings in simple terms. This seems possible when interactions are looked at in pairs of factors, or when factors are examined singly. However, when triple interactions are examined, generalizations are so interspersed with exceptions as to seem futile to attempt.

Nevertheless, a few more tentative interpretations might be offered. Concerning the sex factor, the findings suggest that females in the Faculty of Education are more efficient than males in attaining concepts. It also seems

that, on the whole, females are slightly motivated or unaffected by ego-orienting instructions, while males are slightly hampered by the same instructions. Also, there are no differences in concept attainment efficiency within females attributable to neuroticism but male non-neurotics are slightly superior to neurotic males. However, female non-neurotics are slightly superior to male non-neurotics, and female neurotics are quite superior to male neurotics. Finally, both male and female extraverts are superior to their introverted counterparts, and while there is but a very slight superiority in favor of female over male extraverts, the female introvert is quite superior to the male introvert.

To explain the female's superior concept attainment, it might be argued that females live in an atmosphere which expects them to react to stress in a more socially accepted manner than males. If this were so, one thing which they would have to learn to do would be to acquiesce to the demands placed upon them by this society. In this study, they learned to attain concepts. On the other hand, males at a Summer Session are probably more concerned than women about succeeding in their course work. Passing or failing means more or less money for the rest of their professional careers. Consequently, the suggestion that this was a university level test of ability which was of some interest to their professors

might have acted more disruptively on them than on the females. Alternatively, it might be argued that females are more comfortable with their neuroticism than males, the idea of female neuroticism being very much an accepted part of our present day culture. On the other hand, males are still expected to be embodiments of the strong, silent types. That they are not (especially in the teaching profession) might make it harder for male neurotics to cope with their emotionality than it would for females and partly explain why male neurotics performed more poorly than female neurotics as well as male non-neurotics.

It would seem that the Eysenckian notion that extraversion is a factor in learning is given tentative support in this study. Attempting to translate this in terms of Eysenck's Postulate of Individual Differences, (p. 10), it might be argued that, compared to introverts, extraverts were more successful in attaining concepts because they could inhibit previous problem-solving techniques more quickly and permanently, thereby eliminating more interfering response tendencies. Also, because of the more slowly generated excitatory potential which they are said to possess, the extensive instructions given before the tasks were presented, while they may have bored the introverts, perhaps held the attention of the extraverts more thoroughly throughout. That is, the extraverts may have benefitted most from the instructions and may have

been able to concentrate more easily on the tasks.

It might also be argued on the basis of the data in Table I (p. 9) that in concept attainment tasks of this kind, the extraverts as compared to the introverts were aided by their lower perceptual rigidity, lower persistence and higher speed-to-accuracy ratio. Their lower perceptual rigidity may have allowed them to look at all the attributes on each card instead of looking only for those selected in previous guesses. Their lower persistence may have allowed them to change a guess more easily on the basis of new evidence. Their higher speed-to-accuracy ratio may have allowed them more time to guess and reconsider their guess at the concept within the fourteen seconds alotted between the presentation of instances.

Contrary arguments could perhaps be raised against these two theoretical explanations. However, the fact remains that extraverts do better than introverts, and more rigid interpretations of this superiority must await new research specifically designed for that purpose.

Most of the interpretations just discussed are of course extremely tenuous. The very existence of significant higher order interactions implies that lower order terms do not sufficiently account for the observed results by themselves. In fact, the basic assumption underlying higher order factorial designs is to try to explain variation in experiments more precisely by observing non-additive

effects. However, if the physical sciences may be used as an analagous example, with greater precision comes a loss in generality. This has been the problem which by and large has occupied us here.

What the present study seems to have best illustrated is that findings about concept attainment which are generalized in the absence of individual differences may be limited in their applicability. Thus, it was found that concept attainment efficiency varies as a result of the complicated interactions of personality, sex and phenominological environmental factors. When such third order interactions are taken into account, lower order terms are found to be much less important.

The present study also seems to suggest that much of the previous work in this area has been limited because of the lack of control of variables which might possibly have affected the results. It may happen that when three or four factors are controlled in an investigation, previously significant findings achieved by controlling one or two factors may be placed under considerable strain. For example, it might be argued that the Hullian concept of drive would be supported by an experiment on concept attainment efficiency under stress and non-stress conditions. However, the present findings suggest that the Hullian concept of drive is weakened when emotionality as a factor is also controlled.

CHAPTER VII

SUMMARY, CONCLUSIONS AND IMPLICATIONS

(1) SUMMARY

The purpose of this study was to examine the main and the interaction effects of imposed stress, neuroticism, extraversion and sex on Brunerian-type concept attainment tasks by means of a higher order factorial design. Sixty-four subjects were selected from Educational Psychology 476 Summer Session classes on the basis of extreme and combined scores on the M.P.I. After classifying the subjects on the basis of neuroticism-non-neuroticism, combined with extraversion-introversion, into groups containing at least 8 males and 8 females, half of each group was randomly assigned to either stress or non-stress treatment conditions. After receiving the same instructions in concept attainment, the non-stress subjects were told that the study was to gather group information concerning concept attainment strategies, while the stress subjects were told that they themselves were the object of the study. All subjects completed 12 tasks. The findings may be summarized as follows:

1. A 4-way analysis of variance indicated that groups differed significantly in concept attainment efficiency in terms of the triple interactions of environment,

extraversion and sex, of neuroticism, extraversion and sex, and of environment, neuroticism and sex; in terms of the double interaction of environment and neuroticism; and in terms of the main effect of extraversion. All other effects were found to be non-significant.

2. Clear-cut factorial trends were hard to find but the findings suggest that sex differences are important sources of variation in the interaction of any two of the factors of environment, neuroticism and extraversion.

3. The effects of instructions inducing mild stress are varied within each of the factors of neuroticism, extraversion and sex. Male extraverts, female introverts, and female non-neurotics attain concepts better under stress. Male and female neurotics, and male introverts do more poorly. The other subjects are unaffected by such an environment.

4. The manifestations of neuroticism are different within levels of environment, extraversion and sex. Male neurotics are inferior to female neurotics, male non-neurotic extraverts are superior to male neurotic extraverts, and whereas neurotics tend to be superior to non-neurotics under non-stress, the reverse is definitely the case under stress.

5. The manifestations of extraversion are different within levels of environment, neuroticism and sex. While extraverts and introverts do equally well under non-stress,

extraverts do better under stress. Female introverts are superior to male introverts, and so are male and female extraverts. Non-neurotic extraverts are superior to neurotic introverts.

6. The manifestations of sex are different within levels of environment, neuroticism and extraversion. Under most variables, females perform more efficiently than males. While the sexes are about equal in terms of non-stress, non-neuroticism, and extraversion, females are superior concept attainers in terms of stress, neuroticism and introversion.

7. The 4-factor term failed to even approach significance. This suggests that variations occurring are due not to the interaction of the four factors taken together but to lower order terms.

(2) CONCLUSIONS

1. On the basis of the findings of the present study, the hypothesis suggesting that groups differentiated on the basis of neuroticism, extraversion and sex would differ in their concept attainment efficiency was supported.

2. The findings also support the second hypothesis that such groups will differ in the extent to which their concept attainment performance is affected by a stress situation.

(3) IMPLICATIONS FOR FURTHER RESEARCH

1. The conclusions are based on a sample of only 64 subjects from only one stratum of society. To determine how general the findings are, studies along similar lines should be conducted with younger students, learners in other fields, and, especially, with larger groups.

The importance of research on younger learners arises simply because by far the largest proportion of persons engaged in concept attainment are under the age of twenty-one. This surely suggests the need for research directed to assist concept attainment for this group.

As for learners in other fields, the possibility warrants investigation that perhaps teachers and student teachers have certain idiosyncracies which not only lead them to teaching for a profession but also causes them to react differently than would other groups matched on the same factors in a concept attainment situation. What needs investigation then is whether choice of profession and concept attainment under various levels of control are related.

The use of larger groups would permit the more certain control of variation due to non-normality and to heterogeneity. This would permit more stable statistical results as well as more powerful tests of significance.

2. Further studies in this area should be controlled for differences in intelligence. Alternatively, repeated

measures on the same subjects could be used under each environmental condition. The use of repeated measures on the same subjects would appear to be the simplest solution of the problem. In a study of the present kind, the same groups could be tested under both stress and non-stress environments. To prevent the confounding of effects, the sequence of environments could be alternated equally within groups. It should then be possible to state more conclusively whether or not the results are due to the factors controlled or to any combination of these without worrying about different levels of intelligence within groups.

3. To measure the effect of stress inducement, some experimental procedure should be introduced to quantify stress caused not only by the environment, but also by the tasks themselves. Sarason (1960), for example, found a significant interaction between anxiety, instructions and difficulty. The difficulty of such a control arises though because of the complexity of defining task-simplicity.

For example, difficulty could be a function of such factors as task-novelty, time alotted per instance and per task, the number and nature of instances - whether confirming or infirming, and, positive or negative - the number and nature of attributes - whether familiar or strange, attractive or repulsive, three or nine - and the method of presentation. Difficulty could also be a function of

any combination of these factors.

A need to define task difficulty accurately seems necessary before the further need to control task difficulty in concept attainment experiments can be attempted reliably.

4. The fact that so few main and double interaction terms were found to be significant in the present study suggests that in order to study something as complex as concept attainment, higher order designs are needed to account for variations found.

Statistical analysis is fast approaching a level of sophistication that will make the use of simpler techniques highly questionable. It would appear from the present findings that studies of simple cause and effect or correlated relationships may lead to little more than statistical artifacts of limited research perspective. It certainly seems that a strong argument could be raised for the more frequent use of more sophisticated statistical designs for the investigation of something as complicated as human behavior.

(4) IMPLICATIONS FOR EDUCATION

1. What is commonly accepted as helpful motivation may in fact act detrimentally on emotional pupils. In other words, just as teaching should take individual differences into account, so, perhaps, should motivating instructions.

2. The findings of the present study strongly suggest that the administration of as simple a paper and pencil inventory as the M.P.I. may be useful in understanding differential learning and performance in the classroom. This might also prove of some use in guidance and pupil placement. For example, it may be that a pupil who seems to be coasting rather than striving will achieve as much as his opposite in the classroom. Conversely, the diligent pupil may shatter his teacher's expectations when placed in a stressful environment. Either occurrence might be due to personality, sex or environmental factors such as those controlled in the present study. If subsequent research bears this out then it would seem reasonable 1) to employ such personality inventories with the battery of tests commonly given to pupils in schools; and 2) to use the results of such inventories in preparing pupils for varying environmental conditions, such as final exams; and 3) to use the results of such inventories in pupil-teacher matching.

The last point seems especially important if the learner's best interests are kept in mind. If it is true that certain environments interact with personality and sex differences to affect adversely the course of learning, then it may be important for the teacher to know the nature of these interactions.

3. Sex differences are important sources of

variation in learning situations. More research is needed to determine just how important. For example, it may be that our classroom techniques are geared to facilitate female achievement. If this were found to be the case, it might help to explain why most of the so-called misfits in school are males.

4. The findings of the present study reaffirm the importance of considering individual differences in any teaching situation. They further offer an alternative approach for research to that suggested by Bruner (1961) when he speaks in terms of narrow and broad categorizers. Perhaps educational research could proceed on the fairly firm basis established for the personality dimensions of extraversion and neuroticism.

5. These educational implications are based on the findings of the present study which examined sources of variation in concept attainment. The implications were put forward on the supposition that concept attainment is, or at least will become, the main business of education.

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APPENDIX A

CONCEPT ATTAINMENT TASKS USED, WITH A DESCRIPTION OF THE CARDS PRESENTED, HOW EACH CARD WAS LABELLED, AND THE INFORMATION PRESENTED BEFORE EACH TASK BEGAN.

#1. "3 relevant attributes:- Ignore number, color and kind of figure."

Card no.	Description of card presented	Label
1.	2 green squares, 2 red wavy borders	(+)
2.	2 green squares, 3 blue dotted borders	(-)
3.	2 green squares, 2 red dotted borders	(+)
4.	2 green squares, 1 green solid border	(-)
5.	2 green crosses, 1 red solid border	(+)

Concept:- red border

#2. "4 relevant attributes:- Ignore number and color of border."

Card no.	Description of card presented	Label
1.	3 blue circles, 1 green solid border	(+)
2.	2 blue circles, 3 red solid borders	(+)
3.	2 red circles, 1 blue wavy border	(-)
4.	3 green circles, 2 blud solid borders	(-)
5.	3 blue squares, 3 red solid borders	(+)
6.	3 green circles, 3 red solid borders	(-)
7.	1 blue circle, 1 blue wavy border	(+)

Concept:- blue figure

#3. #5 relevant attributes:- Ignore kind of border."

Card no.	Description of card presented	Label
1.	1 blue cross, 1 red dotted border	(+)
2.	2 green squares, 3 blue dotted borders	(-)

Card no.	Description of card presented	Label
3.	2 red circles, 2 red wavy borders	(-)
4.	2 red circles, 1 red solid border	(-)
5.	2 blue crosses, 3 green wavy borders	(+)

Concept:- blue crosses

#4. "All attributes relevant."

Card no.	Description of card presented	Label
1.	2 blue crosses, 2 red solid borders	(+)
2.	2 red squares, 2 red solid borders	(+)
3.	1 red square, 1 red wavy border	(-)
4.	3 red crosses, 1 blue solid border	(-)
5.	1 green circle, 3 red solid borders	(-)
6.	1 blue cross, 1 blue wavy border	(-)
7.	2 blue crosses, 2 green wavy borders	(+)

Concept:- 2 figures and 2 borders

#5. "4 relevant attributes:- Ignore no. and color of figure."

Card no.	Description of card presented	Label
1.	3 red crosses, 1 blue dotted border	(+)
2.	3 red crosses, 1 blue wavy border	(+)
3.	2 blue circles, 1 red solid border	(-)
4.	2 red crosses, 2 blue wavy borders	(+)
5.	1 blue cross, 1 blue wavy border	(+)

Concept:- cross and blue borders

#6. "5 relevant attributes:- Ignore kind of border."

Card no.	Description of card presented	Label
1.	2 green squares, 3 green dotted borders	(+)
2.	3 green squares, 3 green solid borders	(+)

Card no.	Description of card presented	Label
3.	3 red circles, 1 red solid border	(-)
4.	1 green cross, 1 blue wavy border	(-)
5.	3 blue squares, 3 green wavy borders	(+)
6.	1 red square, 2 blue solid borders	(-)
7.	3 green circles, 3 green solid borders	(+)

Concept:- 3 green borders

#7. "All attributes relevant."

Card no.	Description of card presented	Label
1.	1 green circle, 1 green solid border	(+)
2.	2 green circles, 2 green solid borders	(+)
3.	2 green squares, 2 green solid borders	(+)
4.	3 green circles, 2 red wavy borders	(-)
5.	3 red circles, 3 green solid borders	(+)

Concept:- green solid border

#8. "3 relevant attributes:- Ignore kind of figure, no. and color of border."

Card no.	Description of card presented	Label
1.	3 blue circles, 1 blue wavy border	(+)
2.	1 red square, 3 green solid borders	(-)
3.	1 red circle, 2 red wavy borders	(-)
4.	2 red circles, 1 blue dotted border	(-)
5.	2 blue crosses, 1 red wavy border	(+)
6.	3 red squares, 1 blue solid border	(-)
7.	3 blue circles, 1 green solid border	(+)

Concept:- blue figures

#9. "5 relevant attributes:- Ignore no. of figures."

Card no.	Description of card presented	Label
1.	3 red squares, 2 blue dotted borders	(+)
2.	1 blue circle, 1 red dotted border	(-)
3.	1 green cross, 3 green wavy borders	(-)
4.	3 green circles, 1 blue dotted border	(-)
5.	1 red square, 2 green wavy borders	(+)

Concept:- red square and two borders.

#10. "All attributes relevant."

Card no.	Description of card presented	Label
1.	3 green circles, 2 red wavy borders	(+)
2.	3 green squares, 2 red wavy borders	(+)
3.	1 green square, 3 green solid borders	(-)
4.	1 blue circle, 1 blue solid border	(-)
5.	2 red crosses, 3 green dotted borders	(-)
6.	3 green squares, 1 blue dotted border	(-)
7.	1 red circle, 2 red wavy borders	(+)

Concept:- 2 red wavy borders

#11. "3 relevant attributes:- Ignore no. of figures, no. and kind of border."

Card no.	Description of card presented	Label
1.	3 green crosses, 3 blue dotted borders	(+)
2.	1 green cross, 3 green dotted borders	(+)
3.	1 red circle, 3 red dotted borders	(-)
4.	2 blue squares, 3 red solid borders	(-)
5.	1 green cross, 3 blue solid borders	(+)

Concept:- green cross

#12. "4 relevant attributes:- Ignore kind of figure, color of border."

Card no.	Description of card presented	Label
1.	2 red circles, 2 red solid borders	(+)
2.	2 red circles, 2 red dotted borders	(+)
3.	1 blue square, 3 blue solid borders	(-)
4.	3 green crosses, 1 red solid border	(-)
5.	3 blue circles, 2 green dotted borders	(-)
6.	2 red circles, 1 red dotted border	(+)
7.	2 red squares, 1 green solid border	(+)

Concept:- 2 red figures.

APPENDIX B

INSTRUCTIONS GIVEN TO EACH GROUP BEFORE PROCEEDING

"Hello. My name is Bernie D'Aoust and you are here today to help me write my Master's thesis. The way you will do this is by attempting some concept attainment tasks very similar in nature to those used by Bruner in one of his experiments."

"I will now proceed to tell you something about the tasks and how you are to handle them. Before beginning though let me stress the main ideas to be understood by you. When these are presented, if you don't understand what they mean, please ask any questions that concern you about them. The main ideas to be grasped are (writing them on the board) "concepts", "attributes of a concept", "positive and negative instances" and "relevant attributes." "

1. Show several stimulus cards and point out how they vary in their 6 attribute values." Any questions?"
2. "A concept is a combination of attribute values: i.e. a grouping of instances in terms of common properties.

   e.g. (i) all cards containing crosses (show several)

   (ii) all cards containing green figures (show several)

   Any questions so far?"
3. "Certain cards represent examples of the concept. These are positive instances.

e.g. (i) this card (3 green circles, 1 blue dotted border) is an example of the concept - cards containing three green figures. Read it aloud please.

(ii) so is this card (3 green crosses, 1 red solid border). Read it aloud please.

(iii) and so is this card (3 green circles, III green wavy borders). Read it aloud please."

4. "However, other cards do not represent examples of the concept. These are negative instances.

   e.g. (i) this card (3 blue circles, 1 red dotted border) is NOT an example. Read it aloud please.

   and (ii) this card (3 red crosses, 2 green solid borders) is NOT an example. Read it aloud please.

   and (iii) this card (2 green squares, 1 red wavy border) is NOT an example. Read it aloud please."

5. "I will now show you a sequence of 5 cards and tell you whether each is a positive or a negative instance of the concept I have in mind."

   "After each card, please write down your best guess of the concept as quickly as possible."

   "Do this on the back of the last sheet."

6. Tell them the concept and repeat the presentation of the cards with the concept in mind. Point out why each card was labelled positive or negative.

7. "Please note that each card has six attributes:- number, color, and shape of figure and number, color and kind of border. Each attribute may have one of 3 values each:- 1, 2 or 3; blue, green or red; circle, cross or square; and 1, 2 or 3; blue green or red; dotted, solid or wavy border. Any questions?"

8. "The number of attributes in each task will vary from 3 to 6. You will be told

   (i) how many are relevant and

   (ii) which ones to ignore

   Those to be ignored will definitely NOT form part of the concept, so you can forget about them."

9. "Those remaining, - i.e. the relevant ones - MAY, but do not necessarily make up a part of the concept."

10. "Your problem in finding the concept will be to find which of the relevant attributes DO make up the concept and which do not. In all cases, the concept will consist of not less than one atrribute or more than three. Any questions about what you are trying to do before I tell you how you are to do this?"

11. I am going to give you a series of 12 problems to solve. For each problem, I shall choose a concept and ask you to discover what it is. To help you to attain each concept, I shall first tell you how many attributes in the task may be relevant (i.e. how many the concept *may* include) and which attributes are definitely to be ignored. To further help you, the first card presented in each task will be an example of the concept. And as

a final help, there will be either five or seven cards presented for each problem, and each shall be described as being either a positive or a negative instance of the concept you are seeking. Each card will be shown for ten seconds. On the desk in front of you, there are 12 answer sheets. Please write your name and group number (1, 2, 3, or 4) on the top sheet. Would you then number the first sheet 1 in the top left hand corner, the second sheet 2, and so on to 12. Please notice that each sheet has numbers from one to five, or from one to seven printed on them. When you have seen the first card, I want you to write in the space numbered one on your answer sheet, your best guess of the concept you think I have chosen. Do the same opposite the space numbered 2 for the second card, 3 for the third, and so on to five or seven. Write nothing else but your guesses on the sheets for each task, but write your best guess of the concept for each card. To facilitate the recording of your hypotheses, you may use the abbreviations supplied on the code sheet, and the order of recording suggested there." (Direct attention to the code sheet and give examples of how to use each abbreviation. Answer questions)

"Let me emphasize that you are perfectly free at any time either to repeat a previous guess or to change it. In each problem, a sufficient number of cards has been chosen to enable you to discover the concept. However, it may happen that you will have identified the concept

before the last card is reached; Whether or not this happens, please write down your description of the concept for each card presented. Any questions about this part?"

"I have already mentioned one possible use of the code sheets. I would also like you to use them to cover up your previous descriptions. Thus, when you have seen the first card and written your guess of the concept you think I have chosen, I want you to cover up this description with the code sheet. As you write further descriptions, I want you to slide the code sheet down over the answer sheet so that these are also covered up. YOU MUST NOT LIFT THE CODE SHEET AT ANY TIME TO REFER BACK TO AN EARLIER DESCRIPTION. NOR MUST YOU WRITE ANYTHING BUT YOUR GUESSES ON THE SHEET."

"The way each problem will proceed then is as follows:

1. You will be told which attributes to ignore.
2. An instance will be presented, labelled as positive or negative, and shown for ten seconds.
3. You will then have four seconds in which to write your guess of what you think the concept is, although you may begin to write while the card is being shown.
4. Then, pull down the code sheet so that it just covers what you have written.
5. Repeat the procedure of looking, writing and covering, until the task is finished.
6. Turn to the next answer sheet and repeat the procedure."

"Before beginning, some of you may be wondering about the purpose of all this. We know from other studies that the kind of problem-solving which you are about to engage in is very similar to that encountered in most subject areas dealt with in schools and universities."

(A) for the non-stress group. "Our present concern is to see whether under these conditions of formalized problem-solving, any patterns of solution are used more frequently than others. Since group data is always more meaningful in this type of research, you represent our randomly selected sample. Any questions?"

"We are now ready to begin the first problem."

(B) for the stress group. "Since this is so, it follows that your ability in solving the following problems under time pressure should provide a more accurate measure of your native ability to do university work without undue effort. In other words, you might think of these tasks as an intelligence test specifically designed to measure your ability to learn and to solve problems. Several members of the Educational Psychology staff will help me study and evaluate each set of results." (At this point, Dr. Harper said a few words emphasizing the importance attached to their performance by the staff.)

"We are now ready to begin the first problem."

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